

Infiltration/Inflow (I/I) Reduction Projects

King County, Washington



E & P Subcommittee Meeting
July 16, 2008

Purpose & Feedback

Meeting Purpose

- Inform the E & P Subcommittee about the Status of I/I Reduction Efforts
 - Development of Rehabilitation Costs
 - Methodology of I/I Allocation
 - Development of Initial Rehabilitation Scenarios
 - Analysis Results To-Date
- Respond to Questions
- Obtain Feedback from the E & P Subcommittee

E & P Subcommittee Needed Feedback

- Confirm Methodology Process and Approach
- Provide Input on Initial Rehabilitation Scenario Development and Feedback on Process and Timeline to Choose Final Projects

Project Timeline

Regional Infiltration/Inflow Program Milestones

2007–2008

Predesign feasibility analysis and sewer system evaluation surveys (SSES), select 2-3 initial I/I reduction projects.

2009

Final Design of initial I/I reduction projects. Obtain right-of-entry agreements from property owners.

2010–2012

Construction of initial I/I reduction projects.

2013

Review of project results to determine future I/I reduction projects. King County Executive reviews and submits recommendations to County Council.

Implement regional program

Purpose of Initial I/I Projects

- To Demonstrate & Test the Cost-Effectiveness of I/I Removal on Large Scale
- To Test Planning Assumptions for Use in Future I/I Reduction Planning
- To Learn More from Working on Private Property
- To Provide Models for Successful Future Projects
- To Test Standards, Policies & Procedures

Recap of April E&P Meeting

- General SSES Results
 - CCTV Revealed Moderate Number of Defects in Mains, Laterals and Side Sewers
 - Allocation of I/I Appears to be Uniform Across Basins
- Renton Basin Following Separate Track – City Implementation in 2009
- Skyway Revisions
 - Revised Project Requirements, Timing and Capital Costs for Bryn Mawr Tube Storage
 - Basin BLS002 Included For Evaluation
- Eastgate and Issaquah Basins Present Difficult Rehabilitation Challenges

Development of Unit Costs

- Considered Difficulty of Rehabilitation in Each of the Project Areas
- Focuses on Private Property Rehabilitation
 - CCTV Inconclusive on Specific Sources of I/I
 - Flow Monitoring Suggests Rapid Response Consistent with Private Property I/I
 - Consistent with Pilot Projects; Where 70% to 80% Reductions Achieved
- Focuses on Pipe Bursting
 - Proven Technology
 - Contractor Capability to Complete Large Volumes of Work

Project Area Field Conditions

Easy Rehabilitation

- Low to Moderate Relief
- Direct Side Sewer Routing
- Easy Access to Main and Building Point of Connection
- Typical Restoration



Project Area Field Conditions

Medium Rehabilitation

- Moderate to Steep Relief
- Likelihood of Multiple Bends
- Challenging Access to Building Point of Connection
- Medium Value Restoration



Project Area Field Conditions

Difficult Rehabilitation

- Steep to Extreme Relief
- Shared Side Sewers w/ Multiple Bends
- Challenging Access Building Point of Connection
- Constructed Access to Main Point of Connection
- High Value Restoration and Larger Disturbance Areas



Rehabilitation Difficulty Allocation

- Eastgate
 - Easy – 32%
 - Medium – 31%
 - Difficult – 37%
- Issaquah
 - Easy – 30%
 - Medium – 36%
 - Difficult – 34%
- Skyway
 - Easy – 61%
 - Medium – 25%
 - Difficult – 14%

Development of Unit Costs

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Rehabilitation Unit Costs

Final Unit Costs from Benefit/Cost Analysis

| | UNIT COST | UNITS |
|--|-----------|-------|
| Side Sewer Pipe Bursting (easy) | \$3,500 | EA |
| Side Sewer Pipe Bursting (medium) | \$3,500 | EA |
| Side Sewer Pipe Bursting (difficult) | \$3,500 | EA |
| Lateral/Side Sewer Pipe Bursting (easy) | \$6,800 | EA |
| Lateral/Side Sewer Pipe Bursting (medium) | \$6,800 | EA |
| Lateral/Side Sewer Pipe Bursting (difficult) | \$6,800 | EA |
| Direct Disconnects | \$3,000 | EA |

Skyway Unit Costs

| | UNIT COST | UNITS |
|--|-----------|-------|
| Side Sewer Pipe Bursting (easy) | \$3,310 | EA |
| Side Sewer Pipe Bursting (medium) | \$5,380 | EA |
| Side Sewer Pipe Bursting (difficult) | \$6,600 | EA |
| Lateral/Side Sewer Pipe Bursting (easy) | \$7,295 | EA |
| Lateral/Side Sewer Pipe Bursting (medium) | \$8,515 | EA |
| Lateral/Side Sewer Pipe Bursting (difficult) | \$11,220 | EA |
| Direct Disconnects | \$3,000 | EA |

Issaquah/Bellevue Unit Costs

| | UNIT COST | UNITS |
|--|-----------|-------|
| Side Sewer Pipe Bursting (easy) | \$8,052 | EA |
| Side Sewer Pipe Bursting (medium) | \$9,047 | EA |
| Side Sewer Pipe Bursting (difficult) | \$16,445 | EA |
| Lateral/Side Sewer Pipe Bursting (easy) | \$9,995 | EA |
| Lateral/Side Sewer Pipe Bursting (medium) | \$11,995 | EA |
| Lateral/Side Sewer Pipe Bursting (difficult) | \$16,995 | EA |
| Direct Disconnects | \$3,000 | EA |

Methodology for Development of Alternatives

- Spreadsheet Tool Developed for All Project Areas
 - Incorporated Results of CCTV Data
 - Basin Characteristics Recorded Including Number of Properties and 20-Yr Peak I/I
 - Quantity of Direct Inflow Estimated
 - Remaining I/I Allocated Across Basin
 - Rehabilitation Scenario Developed for Basin
 - I/I Reduction for Scenario Estimated for a Range of Removal Effectiveness
 - BEL031-D Example

Basin Characteristics

Summary of I/I Removal - I/I Reduction

| Description | Source | Quantity | Units |
|---|------------------------------------|----------|-------|
| General | | | |
| Projected 20-year I/I | King County | 1.31 | MGD |
| Assumed inflow estimate | Estimated | 0.063 | MGD |
| Remaining Basin I/I, (I/I minus inflow) | | 1.25 | MGD |
| Acres | King County | 81.7 | ac |
| I/I per acre | | 15,269 | gpad |
| Number of properties | | 213 | |
| Total Quantities in Basin | | | |
| Total length of mainlines | CCTV Inspection | 14,475 | LF |
| Total number of laterals | Assume one lateral per property. | 213 | |
| Total number of side sewers | Assume one side sewer per lateral. | 213 | |
| Total number of lateral/side sewers | Assume one side sewer per lateral. | 213 | |
| Total number of manholes | GIS | 94 | |
| Total number of direct disconnects | Smoke test results | 2 | |

Rehabilitation Scenario

Summary of I/I Removal - Cost Estimates

| Description | Quantity | Unit | Unit Cost | Total Cost |
|---|----------|------|-----------|---------------------|
| Side Sewer Pipe Bursting (easy) | 0 | EA | \$ 8,052 | \$ - |
| Side Sewer Pipe Bursting (medium) | 0 | EA | \$ 9,047 | \$ - |
| Side Sewer Pipe Bursting (difficult) | 0 | EA | \$ 16,445 | \$ - |
| Lateral/Side Sewer Pipe Bursting (easy) | 82 | EA | \$ 9,995 | \$ 819,590 |
| Lateral/Side Sewer Pipe Bursting (medium) | 25 | EA | \$ 11,995 | \$ 299,875 |
| Lateral/Side Sewer Pipe Bursting (difficult) | 75 | EA | \$ 16,995 | \$ 1,274,625 |
| Direct Disconnects | 2 | EA | \$ 3,000 | \$ 6,000 |
| Subtotal | | | | \$ 2,400,090 |
| Sales Tax | | | 9.0% | \$ 216,008 |
| Construction Subtotal | | | | \$ 2,616,098 |
| Allied Cost | | | 53.0% | \$ 1,386,532 |
| Project Cost | | | | \$ 4,002,630 |
| Contingency | | | 30.0% | \$ 1,200,789 |
| Total Estimated Project Cost (2007 Dollars) | | | | \$ 5,203,000 |
| Total Quantities in Basin - Rehabilitated | | | | |
| Total number of side sewers - rehabilitated | | | 0 | |
| Total number of lateral/side sewers - rehabilitated | | | 182 | |
| Total number of performed disconnections | | | 2 | |
| Percent Rehabilitated in Basin | | | | |
| Side sewers rehabilitated | | | 0% | |
| Lateral/side sewers rehabilitated | | | 85% | |
| Performed disconnections | | | 100% | |

I/I Allocation and Reduction

| I/I Allocation in Basin (Private Properties) | | | |
|--|----------|-------|------|
| Percentage of private properties in basin over which I/I (I/I minus inflow) is to be apportioned | Assumed. | 90% | |
| I/I allocation per property (no degradation) | | 4.5 | gpm |
| Number of properties to be rehabilitated | | 182 | |
| Private property estimated I/I reduction assuming 60% reduction (no degradation) | | 0.71 | MGD |
| Private property estimated I/I reduction assuming 75% reduction (no degradation) | | 0.89 | MGD |
| I/I Removal in Basin | | | |
| I/I removal due to performed disconnections (100% reduction assumed) | | 0.06 | MGD |
| I/I removal due to private property rehabilitations (60% I/I reduction assumed per fixed property) | | 0.71 | MGD |
| I/I removal due to private property rehabilitations (75% reduction assumed per fixed property) | | 0.89 | MGD |
| Summary: I/I Removal (60% I/I Reduction Assumed for Private Properties; No Degradation) | | | |
| Total I/I Removal | | 0.77 | MGD |
| Minimum Remaining I/I | | 0.5 | MGD |
| Minimum Remaining I/I | | 6,571 | gpad |
| Summary: I/I Removal (75% I/I Reduction Assumed for Private Properties; No Degradation) | | | |
| Total I/I Removal | | 0.95 | MGD |
| Minimum Remaining I/I | | 0.4 | MGD |
| Minimum Remaining I/I | | 4,397 | gpad |

Current Scenarios

- Over 50 Scenario Alternatives Evaluated
- Scenarios Included Evaluation of Single Basins, Multiple Basins, and Work in Multiple Project Areas
- Scenario Example BEL/ISS-BH and BEL/ISS-BL
 - Includes Rehabilitation in One Eastgate Basin and One Issaquah Basin
 - Rehabilitation of 107 Properties in Eastgate and 113 Properties in Issaquah for a Total of 220 Properties
 - Estimated Construction Cost of \$3.41 M; Estimated Project Cost of \$5.23 M
 - Estimated Removal of 0.85 to 1.04 MGD Peak I/I
 - Reduces Eastgate Storage by 260K - 320k Gal; Reduces Issaquah Tube Storage 370k - 450k Gal
 - CSI Project Cost Savings of \$5.60 M to \$6.97 M
 - Resulting Cost/Benefit Ratio of 1.07 - 1.33

Current Scenarios

- Most Promising Basins for Rehabilitation
 - BEL031
 - ISS003
 - BLS002 & BLS003
- Most Cost-Effective Scenarios
 - BEL-I B/C Ratio = 1.17 – 0.97
 - BEL-J B/C Ratio = 1.13 – 0.93
 - BEL-K B/C Ratio = 1.50 – 1.24
 - ISS-E B/C Ratio = 1.18 – 0.93
 - ISS-F B/C Ratio = 1.23 – 0.96
 - ISS-G B/C Ratio = 1.36 – 1.08
 - BEL/ISS-B B/C Ratio = 1.33 – 1.07

Current Scenarios

- Skyway Scenarios
 - Rehabilitation Does Not Appear Cost-Effective Despite High I/I Allocation
 - Relative to Other Project Areas, High I/I Removal Quantity Required to Eliminate Bryn Mawr Tube Storage
 - Hydrograph Characteristics, Low Storage Volume and High Property Acquisition Costs are Factors

E&P Subcommittee Input and Next Steps

- Does the E&P Subcommittee have comments or questions regarding the presented evaluation methodology and approach
- Does the E&P Subcommittee have input on additional information that should be evaluated
- What input does the E&P Subcommittee have on selection of final projects
 - Additional evaluation required to make decision
 - Process of selection
 - Timing/Dates for next E&P Subcommittee and MWPAAC meetings
 - Project Selection September 3, 2008
 - MWPAAC Approval September 24, 2008